

SPECIFICATION NO.TI/SPC/OHE/MRI/0140

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS



TECHNICAL SPECIFICATION
FOR
MEASURING AND RECORDING INSTRUMENTATION TO BE
RETROFITTED ON 8-WHEELER TOWER CARS

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Chapter - I

GENERAL CONDITIONS

1.1 SCOPE

1.1.1 This specification covers the Design, manufacture, supply, testing & retrofitment/commissioning of OHE Parameter Measuring & Recording instrumentation on existing self-propelled 8-Wheeler Diesel Electric Tower Car and self-propelled 8-Wheeler Diesel Hydraulic Tower Car operating on broad gauge (1676mm) electrified (25 kV A.C.) routes of Indian Railways. The work involve is to design & development of instrumentation and retrofitment of these instruments on 8-Wheeler Diesel Electric and Diesel Hydraulic Tower Cars. The Retrofitment work for existing Tower Car shall be done during periodical overhauling (POH). Supply of new 8-Wheeler Tower Car shall be made duly fitted with measuring & recording system as per Specification; wherever specified.

1.2 CLIMATIC CONDITIONS

1.2.1 The instrumentation shall be in continuous operation under the following atmospheric and climatic conditions: -

1	Atmospheric temperature	Metallic surface temperature under Sun: 75°C maximum and in shade: 55°C max. Minimum temperature: -10°C (Also snow fall in certain areas during winter season).
2	Humidity	100% saturation during rainy season.
3	Reference site conditions	i) Ambient Temp. : 50°C ii) Humidity: 100% iii) Altitude: 1000m above mean sea level.
4	Rain fall	(i) Ranging from 1750 mm to 6250 mm. (ii) Number of rainy days/annum 120
5	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach as high as of 1.6 mg/m ³ . In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.
6	Coastal Area	Instrumentation shall be designed to work in coastal areas in humid and salt laden atmosphere with maximum pH value of 8.5, sulphate of 7mg per liter, max. concentration of chlorine 6 mg per liter and maximum conductivity of 130 micro siemens/cm.
7	Vibration	The equipment, sub-system and their mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in clause 1.2.2. High level of 50 g vibration and shocks. Accelerations over 500 m/s ² have been recorded at axle box levels for long periods during run.

		Vibrations during wheel slips are of even higher magnitude.
8	Wind Speed	High wind speed in certain areas, with wind pressure reaching 200kg/m ²

1.2.2 The equipment and their arrangement shall withstand satisfactorily, the vibration and shocks normally encountered in service which are as below:-

- | | |
|---------------------------------------|------|
| (a) Maximum Vertical Acceleration | 3.0g |
| (b) Maximum Longitudinal Acceleration | 5.0g |
| (c) Maximum Train Acceleration | 2.0g |
- Where g= Acceleration due to gravity

1.3 EXAMINATION OF THE TENDER OFFER:

- 1.3.1 The tenderer is required to furnish clause by clause comments to this specification, either confirming acceptance of the clause or indicating deviation therefrom.
- 1.3.2 Details of all Measuring Instruments, covering all technical and functional requirements, given in the Specification, shall be brought out by the Tenderer, while quoting. List of Measuring Instruments shall be furnished along with the offer by the tenderer for scrutiny.
- 1.3.3 In the event a tenderer is unable to comply, either partially or fully, to any of the stipulations made in this specification, it must be brought to the notice of purchaser with full particulars of the deviations, technical details, cost implications and past service performance, etc.

1.4 DESIGN DEVELOPMENT:

- 1.4.1 The successful tenderer (hereafter called as contractor) shall develop the design based on the details given in this specification and sound engineering practices. The entire design shall be submitted to RDSO for approval before commencing retrofitment of instrumentation system.
- 1.4.2 The design shall be based on S.I. Units.
- 1.4.3 From the information given in this specification and instructions of RDSO, the contractor shall prepare a full set of engineering drawings for retrofitment of instruments for monitoring vital OHE parameters and submit the same to RDSO for approval.
- 1.4.4 Material specifications, manufacturing tolerances and other details, such as jigs & fixtures which are necessary for retrofitment of instruments shall be indicated in the drawings.

- 1.4.5 Tenderer shall inspect the existing self-propelled 8-Wheeler Diesel Electric & Diesel Hydraulic Tower Cars available on Indian railways for space availability, locations for fixing instruments/equipment and to develop the suitable instrumentation for retrofitment and also control cubicle for recording and monitoring.

1.5 APPROVAL OF DRAWINGS:

- 1.5.1 "Approval" to the drawing means the approval to the general adoptability of the design features. RDSO shall not be responsible for the correctness of dimensions on the drawings, materials used, strength or performance of the components. The contractor shall be wholly and completely responsible for all these variables. The contractor, when submitting proposals or designs for approval of the RDSO, shall draw attention to any deviation or departure from the specification involved in his proposals or drawings.
- 1.5.2 Drawing for approval shall be submitted in standard size (s) as per IS: 696 along with main calculation details in triplicate.

1.6 PRINTS:

- 1.6.1 One set of tracing, two sets of their prints & two DVD of the RDSO approved drawings/ calculations shall be supplied by the successful contractor with each system supplied for tower car. The tracings shall be on RTF of durable quality. Drawings shall be made on Auto CAD. Two sets of tracing, two sets of prints and two copies of approved drawings & calculations along with 3 DVDs shall be supplied to RDSO.
- 1.6.2 Diagram sheets showing the overall dimensions of the instrumentation, weights and the relation of overall dimensions to the space in the Tower Car.

1.7 CONTRACTOR'S RESPONSIBILITY:

- 1.7.1 The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms of this specification and the conditions of contract, notwithstanding any approval which RDSO or the Inspecting officer may have given:
- (a) Of the detailed drawing prepared by the contractor.
 - (b) Of the sub-contractors for materials.
 - (c) Of other parts of the work involved by the contractor.
 - (d) Of the tests on instrumentation either by the contractor or by the RDSO or the Inspecting Officer.

1.8 WARRANTY

Warranty shall be as per IRS standard conditions of contract.

1.9 DRAWINGS AND STANDARD SPECIFICATION

1.9.1 The Contractor shall prepare all the drawings for installation of instrumentation on Diesel Electric /Diesel Hydraulic Tower Car for approval.

1.9.2 Indian Railways Standard (IRS) Specifications and Schedules of Maximum Moving Dimensions may be obtained on payment from the Manager, Government of India Publications, Civil Lines, Delhi 110 006 (INDIA).

1.9.3 Indian Standard Specifications (ISS) are available from Bureau of Indian Standards, 9-Bahadur Shah ZafarMarg, Delhi 110 002.

1.10 SERVICE ENGINEERING:

1.10.1 The Contractor shall arrange for the supervision of commissioning of the instrumentation immediately after their receipt at ultimate destination. He is also required to carry out joint check of the receipt of components regarding short shipment or transit damages.

1.10.2 The contractor shall ensure commissioning of the instrumentation within 30 days from the date of intimation by the consignee.

1.10.3 The performance of instrumentation shall be demonstrated by the contractor after its successful commissioning at the consignee's works.

1.10.4 The contractor shall provide and ensure servicing facilities in India throughout the warranty period. After the warranty period is over, he shall, on call, give service support for troubleshooting and for obtaining spare parts.

1.11 TRAINING

1.11.1 The Contractor shall arrange to provide training in operation & maintenance of the instrumentation at their manufacturing works for two men for four days and two men for four days at user place for each set of instrumentation supplied for each Tower Car. The training material shall be supplied by the contractor. The charges for training shall be included in the price of instrumentation supplied. The charges for travel, boarding and lodging of trainees shall be borne by the Railways.

1.12 SERVICE MANUALS AND SPARE PARTS CATELOGUE:

1.12.1 Detailed Maintenance & Service Manuals including the manual for trouble shooting & operational requirement, spare parts catalogues for the operator and maintenance staff with each set of instrumentation supplied with each Diesel Electric or Diesel Hydraulic Tower Car shall be prepared and three copies supplied free of cost.

1.12.2 In addition, three copies each of the Maintenance/Service and troubleshooting manual shall be supplied to RDSO.

1.13 SUBLET ORDERS FOR MATERIALS: Any subletting of orders for materials/work shall have prior approval of RDSO.

1.14 SPARE PARTS:

1.14.1 Unit exchange of spare parts shall be indicated. However, final decision to buy these will rest with the purchaser.

1.14.2 The prices for these spares shall be quoted separately. These spares shall be for each set of instrumentation supplied.

1.14.3 The tenderer shall be responsible to ensure subsequent availability of the spare parts for the normal life of the respective instrument.

1.15 QUALITY ASSURANCE PLAN

1.15.1 The contractor should possess valid ISO-9001:2000 certificate for his work's address. The contractor shall formulate Quality Assurance Plan (QAP) detailing the methodology proposed to be followed for retrofitment, testing & commissioning of instrumentation on Tower Car.

1.16 ANNUAL MAINTENANCE CONTRACT (AMC)

(The instructions given below in the paras are indicative. Please refer tender conditions in the tender document for details.)

1.16.1 The Tenderer shall quote for AMC of all Equipments/Components of Measuring& Recording System such as Transducers, Load Cells, Strain Gauges, High Resolution Camera, On Board Computers/Laptop, Laser Printers, UPS and other Interface Equipment. The Annual Maintenance shall be for 5 years after warranty period is over. The Tenderer shall quote year wise rates of AMC detailing the various maintenance schedules enlisting the requirement of material/ spare parts, consumables, and services to be rendered by him in regular intervals. All these materials, spare parts, consumables and labour requirement shall be arranged by the successful Tenderer during the course of AMC. The AMC shall be comprehensive for all Equipment of Measuring &

Recording System covering scheduled as well as break down maintenance. The Tenderer shall keep adequate spares in stock accordingly. AMC shall be inclusive of replacement of parts, if required, either due to breakdown or due to regular wear and tear.

- 1.16.2 The cost of AMC cost of Measuring System shall be considered while evaluating the inter-se tender position. It shall be compulsory for the Tenderer to quote for AMC without which the offer shall be summarily rejected.
- 1.16.3 Tenderer shall submit various maintenance schedules such as Daily/Weekly, Monthly, Quarterly, Half yearly and Yearly schedules of all Equipments along with the offer.
- 1.16.4 During warranty period, scheduled maintenance of Measuring Equipment/ Components shall be done by the successful contractor for which no extra cost shall be paid by the Railways. After expiry of Warranty period, the successful Tenderer shall have to maintain all the instrument/ Components of the Measuring System during AMC period of 5 years. The Equipment, other than measuring instrumentation/ Components, shall be maintained by the Railways.
- 1.16.5 In case of failure of any Equipment, during Warranty as well as AMC period, it shall be repaired or replaced within reasonable time not exceeding 05 days from the day of reporting by the consignee. After this period of 05 days, penalty at the rate of Rs. 5000 (Rupees Five Thousand) per day (flat) shall be imposed on the contractor for each day, or its part thereof.
- 1.16.6 The AMC agreement shall be entered separately with each Zonal Railway as per the accepted rate of the Contract.

CHAPTER – II

MEASURING & RECORDING SYSTEM

- 2.1 The instrumentation shall be able to measure and record the required parameters in the speed range 0-110 kmph, when running in self-propelled mode/coupled to a train.
- 2.2 The system requirement shall be on line recording, storing and online processing. In this setup, video recording of the OHE shall be carried out and shall process on line with on board computer kept in the Tower Car to process the necessary information of the OHE geometry parameter as mentioned in the clause 2.7.1 (a) to (e). The hot spot on the OHE shall be detected using Infra-Red camera and this shall also be processed online on on-board computer. Processed report of OHE geometry from the on-board computer to the nominated Railway Official sitting at the Remote Control Centre through internet shall be transmitted. The type and details in Report shall be finalized at the designs approval stage.
- 2.3 The tender shall give offer with complete technical details including processing software for analysis of OHE Geometry and report generation. The software shall be capable of exporting data to MS office for analysis.
- 2.4 The measurements shall be made under live or non-live condition of the OHE, during day and night.
- 2.5 The pantograph of Tower Car may be fitted with instrumentation such as transducers, accelerometer, load cells and strain gauges etc. as required but such fitment shall not materially affect the static/dynamic performance of the Tower Car pantograph. The sensors are preferably to be installed on the roof of car and non-contact measurement shall be preferred. The transducers shall be properly protected against mechanical, environmental and electrical interferences. The cameras shall have high resolution high frequency suitable for capturing of images at the specified speeds. The cameras and other equipment shall be protected for ingress of dust and water with IP -65 Protection.

For parameters like contact wire height, stagger, loss of contact, setting distance (implantation) and thickness/diameter of contact wire, contact-less measurement system employing state of the art technology shall be acceptable conforming to environmental standards. The system shall be designed according to electromagnetic compatibility, Shocks vibrations and shall have no moving parts, completely sealed and rugged construction.

The communication between exterior/roof mounted and interior instruments on board computer/laptop shall be made by an Ethernet Network and physical connection is made by optical fiber. All cables on

the roof of tower car which are connected to ground level shall be put in a metallic grounded protection pipe.

The system shall be precise and needs less frequent calibrations. The tendered shall submit a detailed scheme of the proposed system with technical details including dimensional requirement and performance report of the system supplied and commissioned over worldwide Railways.

2.6 RETROFITMENT OF MEASURING SYSTEM

2.6.1 All processed information shall be made available in the Laptop/Desktop at the suitable location in the Dome Area or Staff Cabin of Tower Car. The connections from instrumentation on the roof of the car to the place inside the Tower Car shall be rigid enough to avoid any failure due to poor connectivity during movement of Tower Car due to vibrations. Necessary minor modification work for keeping Laptop/Desktop, UPS, Printer and power supply arrangement for Laptop/Desktop, Printer shall be in the scope of supply.

2.6.2 The electric supply shall be made available from 7.5 kVA DG set, 440V, 3 phase supply. The tenderer shall draw single phase supply from DG Set for supply to UPS. The UPS shall have a backup of atleast 3 hours in the event of failure of DG Set. The capacity of battery with UPS shall be furnished while submitting the design for approval of RDSO.

2.7 PARAMETERS TO BE MEASURED.

2.7.1 Principles/methods used for the measurements as indicated in each of the following clauses are only suggestive and the successful tenderer should employ state-of-art technology capable of high accuracy and precision in measurement and recording. All corrections/compensations due to bogie, body and pantograph oscillations shall be built into the measurement methods for giving better accuracy/precision in measurement and recording. The parameters that the tower car is required to measure and monitor are detailed as follows:

a) HEIGHT OF CONTACT WIRE

The height of the Contact Wire is vertical distance of its underside from the rail level and it varies from 4500 mm to 6500 mm. The height measurement should be corrected for car-body movement. Height of contact wire may be measured using any non-contact measurement methodology. The Car shall be able to measure heights of two contact wire of main line OHE and of Turnout OHE to ensure a gap of 50 mm at support points at obligatory structures(out of run OHE to be higher than main line OHE). This is essential to avoid pantograph entanglement

with OHE. Continuous measurement of main line and Turnout OHE is required at such locations. The accuracy of height measurement shall be minimum ± 10 mm. Sampling distance shall be 1000 mm.

b) STAGGER OF CONTACT WIRE.

Stagger is defined as the distance of the contact wire from the center-line of pantograph, measured transverse to the track. (Suitable cant compensation shall be made for transverse oscillations of the locomotive/OHE car which affect the center line of the pantograph from the vertical). The system employed should enable measurement of stagger of two contact wires simultaneously (at overlaps and turnouts) upto a limit of ± 500 mm. The stagger of contact wire may be measured using any non-contact measurement method. The accuracy of stagger measurement should be minimum ± 10 mm. Sampling distance for Stagger measurement shall be 500 mm.

c) MEASUREMENT OF CONTACT WIRE THICKNESS (CONTACT WIRE DIAMETER)

Thickness implies the diameter of Contact Wire. There are three sizes of contact wire i.e 107 mm^2 , 150 mm^2 and 193 mm^2 and their diameters are 12.24 mm, 14.50 mm and 16.40 mm respectively. The condemning limits of their diameters are 8.25 mm, 8.25 and 9.75 mm respectively. The measurement of diameter of contact wire may be made using any non-contact measurement method. The accuracy of contact wire thickness measurement shall be minimum ± 0.2 mm. Sampling distance shall be 500 mm.

d) LOSS OF CONTACT

Loss of contact with pantograph and contact wire is required to be continuously monitored. For this continuous recording/measurement of the contact force between the pantograph and the contact wire, which may differ from the upward force of the pantograph, due to oscillations of the contact wire, shall be made by suitable transducers installed on the pan of the pantograph. Force sensors shall be small and lightweight so as not to affect the aerodynamic uplift and current collection property of the pantograph.

e) MEASUREMENT OF SETTING DISTANCE (IMPLANTATION)

Setting Distance is distance measured from centre line of track to the inner face of traction mast. This varies in the range of 2100 mm to 5000 mm. System should be able to measure the setting distance in accuracy level of ± 10 mm. System should be able to have Data storage of at least 10 lakh masts and transfer it for printing of reports.

Note: Tenderer may propose any other method, which is superior, more accurate and suitable to measure at higher speed of tower car, may be offered for items at para-2.7 above. For this tenderer have to submit the detailed procedure and justification for acceptance of the purchaser. Contractors' design shall have earlier given satisfactory performance for a minimum period of two years on railway networks elsewhere.

2.7.2 MAST IDENTIFICATION SYSTEM

The GPS receiver shall identify the location of OHE masts co-relating with measured data. Geographical positioning system shall be utilized for the mast identification along the track. The GPS/optical mapped data is in text file and shall be required to be correlated with the software of measuring instrument system so that the location of the measured data is automatically displayed/ printed along with the event recorded. Accordingly, chart recorder/ report output shall indicate the exact location of recorded event, giving the mast number. Alternatively optical identification system can also be employed to detect the Catenary Wire support (Mast) along the track continuously. The Optical Mast Identification system shall be active where GPS is not visible such as through tunnels and other critical locations. GPS data shall be transferable to PC/Laptop using suitable software and accessories. The GPS data shall be provided by the Railways. Antenna of sufficient cable length shall also be provided. The accuracy required for mast location shall be minimum ± 4 meter.

2.8 RECORDING AND PRESENTATION OF TEST RESULTS:

2.8.1 All processed results shall be presented with reference to the specific mast location on the track and kilometerage. It should be possible to initialize the reference kilometers by the operator at any stage. All distance measurements after initializing the kilometer shall be with reference to kilometer so entered till the next initializing by operator.

2.8.2 The exact format for presentation of reports over computer monitor and plotter/printer shall be mutually decided after award of the tender. Such presentation may take the form of continuous display correlated with the mast location and recorded parameters and kilometric progressive over a suitable scale or may take the form of reports generated on the basis of exceedance of certain threshold values. The processing software shall take care of the requirement of IR gauge and OHE for the purpose.

2.9 RECORDING FACILITY

2.9.1 All parameters shall be recorded and archived on a suitable multi-channel recorder. The storage space shall be adequate for storing information for a cumulative run of 1000 kms or 90 days whichever is less.

2.9.2 All measured and recorded data shall be converted from analog to digital form, classified, analysed and stored on an On-Board computer based data acquisition and analyzer system. It shall be possible to generate suitable reports involving simple logic from the database.

2.9.3 It shall be possible to print out all or any of the parameters in juxtaposition as a function of distance or mast location without any classification, if desired. Normally the data shall be required to be printed after classification and analysis as specified.

2.9.4 Suitable recorder is to be provided for recording all parameters in juxtaposition for off-line processing. The resolution of the parameters recorded shall be commensurate with the variation of the recorded value.

2.10 EMI REQUIREMENTS

2.10.1 The instrumentation shall be work under 25 kV, 50 Hz, OHE System environment. Electronic signals generated inside the measuring equipments, inverters shall work without any adverse performance.

2.10.2 The tracks over which the offered system will work may be equipped with DC track circuits, 83-1/3 Hz track circuits as well as track circuits at higher frequencies. Harmonics generated by the measuring equipment should not affect signaling gears like audio frequency track circuits and axle counters which work in the range 0-5 kHz with a limit of 400 mA. On the communication network, control circuits, tele-printer circuits, as well as VHF/UHF and microwave circuits are employed. The Psophometric voltage induced on communication circuit running by the side of track should not exceed 1 mV.

2.10.3 The electric and electronic equipment used in the measuring & recording instrumentation System shall comply emission and immunity aspects of EMC to CENELEC standard EN-50121-3-2. The internal EMC shall cover a combination of earthing, shielding and isolation of interference sources so that conducted and radiated noises are properly segregated or suppressed and no other equipment is affected due to operation of measuring equipment. The following interference current in the output current waveform shall not be exceeded at any point in the operating envelope of the Car:

Psophometric Current ≤ 5 A

100 Hz - 400 mA

1700 $\pm$ 50 Hz - 300 mA

2000 $\pm$ 50 Hz - 300 mA

2300 $\pm$ 50 Hz - 300 mA

2600 $\pm$ 50 Hz - 300 mA

5100 $\pm$ 50 Hz - 100 mA

2.10.4 Emission from Tower Car to outside world shall be limited to level specified under CENELEC standard 50121-2. The tenderer shall submit the simulated values of these interference currents in their offer.

2.11 INSPECTION & TESTING OF MEASURING & RECORDING INSTRUMENTS

2.11.1 Successful tenderer shall arrange all facilities to conduct performance tests of the measuring instruments as per the required features of the instrument.

2.11.2 Tenderer shall give complete details of tests schedule for conducting tests to assess the capability of all measuring equipment. The test shall preferably be conducted in 25 kV. Traction or similar environment to establish compliance of the measuring capability of OHE parameters.

2.11.3 The tests related to design & other physical parameters shall be witnessed by the authorised representative of purchaser at supplier's premises.

2.11.4 The cost of inspection and testing charges shall be borne by successful tenderer. However, for lodging and boarding charges shall be borne by purchaser.

2.11.5 CALIBRATION OF MEASURING EQUIPMENT

The measuring equipment shall be calibrated by the supplier at the time of commissioning in presence of the Railway Engineers. The calibration of measuring devices shall also be carried out periodically during the Annual maintenance.